Notice No. 3

Rules for the Manufacture, Testing and Certification of Materials July 2013

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Issue date: July 2014

Amendments to	Effective date
Chapter 1, Sections 3, 5 & 6	1 July 2014
Chapter 2, Section 3	1 July 2014
Chapter 3, Section 9	1 July 2014
Chapter 4, Sections 8 & 9	1 July 2014
Chapter 5, Section 9	1 July 2014
Chapter 7, Sections 1, 3, 4 & 5	1 July 2014
Chapter 10, Sections 1, 2, 3, 4 & 6	1 July 2014
Chapter 12, Section 6	1 July 2014
Chapter 13, Sections 1 & 9	1 July 2014

Lloyd’s Register

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Chapter 1

General Requirements

Effective date 1 July 2014

■ *Section 3*
Certification of materials

3.1 General

(*Part only shown*)

3.1.3 The following certificate types are to be used, (a) and (b) for the Materials Survey Scheme, and (d) for the Materials Quality Scheme:

(d) **Manufacturer's certificate issued under the Materials Quality Scheme**
Where a manufacturer is approved according to the Materials Quality Scheme, they will issue manufacturer's certificates bearing the scheme mark. The certificates must also bear the following statement:
"This certificate is issued under the arrangements authorised by Lloyd's Register (operating group) in accordance with the requirements of the Materials Quality Scheme and ~~certificate~~ scheme number MQS ……..”

■ *Section 5*
Non-destructive examination

5.2 Personnel qualifications

5.2.1 The shipyard, fabricator or manufacturer is to ensure that personnel carrying out non-destructive examination or interpreting the results of non-destructive examination are qualified to the appropriate level of a nationally recognised scheme such as ISO 9712, ~~EN 473,~~ PCN, ACCP or SNT-TC-1A. Level 1 personnel are not permitted to interpret results to Codes or Standards.

■ *Section 6*
References

6.1 General

(*Part only shown*)

Table 1.6.1 List of National and International Standards

Rule reference	Standard
Chapter 1 – General Requirements	ISO 9001: 2008 SNT-TC-1A:2012 ISO 9712:2012
Chapter 2 – Testing Procedures for Metallic Materials	ASTM E23-~~07a~~Rev C (2012)
Chapter 3 – Rolled Steel Plates, Strip, Sections and Bars	ASTM E112-~~2010~~Rev C (2012) ISO 7452:2002 ASTM E208-06
Chapter 4 – Steel Castings	ASTM G48-11 ISO 1161: 1984/Amendment 1: 2007
Chapter 5 – Steel Forgings	ASTM E112-~~2010~~12 ASTM G48-11
Chapter 11 – Approval of Welding Consumables	ASTM G48-~~03 (2009)~~11
Chapter 12 – Welding Qualifications	ASTM G48-11 ISO 25239-3: 2011 ISO 25239-4: 2011
Chapter 13 – Requirements for Welded Construction	~~EN 473: 2008~~ ISO 25239-5: 2011
Chapter 14 – Plastics Materials	ISO 527-2: ~~1993/corr1:1994~~2012 ISO 1922- ~~2001~~2012 ASTM C273/C273M-~~06 2011~~11 ASTM C393/C393M-~~2011~~11

Chapter 2

Testing Procedures for Metallic Materials

Effective date 1 July 2014

■ *Section 3*

Impact tests

3.1 Dimensions of test specimens

~~**Table 2.3.1 Dimensions and tolerances for Charpy**~~ **V-notch impact test specimens**

Dimension	Nominal	Tolerance
Length, mm	55	±0,60
Width, mm– standard specimen	10	±0,11
– standard subsidiary specimen	7,5	±0,11
– standard subsidiary specimen	5	±0,06
Thickness, mm	10	±0,06
Angle of notch	45°	±2°
Depth below notch, mm	8	±0,06
Root radius, mm	0,25	±0,025
Distance of notch from end of test specimen, mm	27,5	±0,42
Angle between plane of symmetry of notch and longitudinal axis of test specimen	90°	±2°

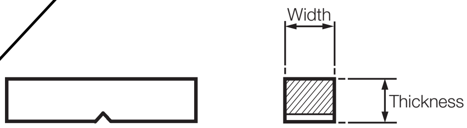
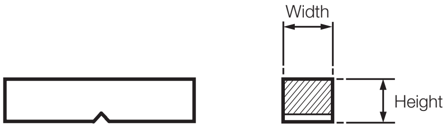


Table 2.3.1 Dimensions and tolerances for Charpy V-notch impact test specimens

Dimension	Nominal	Tolerance
Length, in mm	55	±0,60
Height, in mm, *see* Note 1	10	±0,075
Width, in mm, *see* Note 1		
– standard specimen	10	±0,11
– standard subsidiary specimen	7,5	±0,11
– standard subsidiary specimen	5	±0,06
Angle of notch	45°	±2°
Height below notch, in mm	8	±0,075
Root radius, in mm	0,25	±0,025
Distance of plane of symmetry of notch from ends of test piece, in mm, *see* Note 1	27,5	±0,42, *see* Note 2
Angle between plane of symmetry of notch and longitudinal axis of test piece	90°	±2°
Angle between adjacent longitudinal faces of test piece	90°	±2°



NOTES

1. The test piece is to have a surface roughness better than R*a* 5 µm except for the ends.
2. For machines with automatic positioning of the test piece the tolerance is to be taken as ±0,165 mm.

Chapter 3

Rolled Steel Plates, Strip, Sections and Bars

Effective date 1 July 2014

■ *Section 9*

Bars for welded chain cables

9.9 Non-destructive examination

9.9.1 For the grades U1, U2 and U3 all bars are to be free from internal and surface defects that might impair proper workability, use and strength. Subject to agreement by the Surveyor, surface defects may be removed by grinding provided the acceptable tolerances are not exceeded.

Existing paragraphs 9.9.1 *to* 9.9.5 *have been renumbered* 9.9.2 *to* 9.9.6.

9.11 Certification of materials

9.11.1 Each consignment of bars is to be accompanied by a certificate of a type and in accordance with 1.12, but with the addition of the grade of chain cable, the rolling reduction ratio, the results of the hydrogen embrittlement, micro inclusion, macro etch and hardenability tests, where required by each grade.

Chapter 4
Steel Castings

Effective date 1 July 2014

■ *Section 8* Stainless steel castings

8.2 Chemical composition

(*Part only shown*)

Table 4.8.1 Chemical composition of stainless steel castings

Type of steel	Chemical composition %								
	C	Si	Mn	S	P	Cr	Mo	Ni	Others
Duplex									
~~UNS S 31803~~	~~0,03~~	~~1,00~~	~~2,00~~	~~0,025~~	~~0,035~~	~~21,0–23,0~~	~~2,5–3,5~~	~~4,5–6,5~~	~~N~~ ~~0,08–0,20~~
UNS J 92205 (*see* Note 3)	0,03	1,00	1,50	0,020	0,035	21,0–23,0	2,5–3,5	4,5–6,5	N 0,15–0,20 Cu 1,00

NOTES
3. The grade UNS J 92205 is the cast equivalent of UNS S 31803.

(*Part only shown*)

Table 4.8.2 Mechanical properties for acceptance purposes: stainless steel castings

Type of steel	Tensile strength N/mm^2 minimum	1,0% proof stress N/mm^2 minimum	Elongation on $5,65\sqrt{S_o}$ % minimum	Reduction of area % minimum	Charpy V-notch impact tests	
					Test temperature °C	Average energy J minimum
Duplex						
~~UNS S 31803~~ UNS J 92205 (*see* Note)	600	420	20	35	0	41

NOTE
The grade UNS J 92205 is the cast equivalent of UNS S 31803.

8.5 ~~Intergranular corrosion~~ Corrosion tests

8.5.1 ~~Where corrosive conditions are anticipated in service, intergranular corrosion tests are required on castings in grades 304, 316, 317 and all duplex stainless steels. Such tests may not be required for grades 304L, 316L and 347.~~ Where corrosive conditions are anticipated in service, for grades 304, 316 and 317, intergranular corrosion tests are required in accordance with Ch 2,8.1. Such tests may also be required for grades 304L, 316L and 347.

8.5.2 ~~Where an intergranular corrosion test is specified, it is to be carried out in accordance with the procedure given in Ch 2,9.1.~~ Where corrosive conditions are anticipated in service, for duplex stainless grades pitting corrosion tests are required in accordance with ASTM G48 Method C. For duplex stainless steel grade UNS J 92205 the test temperature is to be 20°C. Following the test, no pitting corrosion is to be observed at 20x magnification. The use of a weight loss method may be accepted subject to special consideration.

■ *Section 9* Steel castings for container corner fittings

9.8 Certification of materials

9.8.1 For each consignment an LR certificate, *see* Ch 1,3.1, is to be issued for castings made under LR survey or alternatively a manufacturer's certificate is to be issued ~~(see Ch 1,3.1),~~ containing at least the following:

(a) Purchaser's name and order number.
(b) Grade of steel.

(c) Drawing and/or specification number.
(d) Cast number and chemical composition.
(e) Details of the heat treatment.
(f) Number and weight of the castings.
(g) Results of inspections and mechanical tests.

See Ch 1,3.1, for manufacturers approved under a Quality Assurance Scheme.

Chapter 5

Steel Forgings

Effective date 1 July 2014

■ *Section 9* ~~Austenitic stainless~~ Stainless steel forgings

9.1 General

9.1.1 Forgings in austenitic and duplex stainless steels are acceptable for use in the construction of cargo tanks, storage tanks and piping systems for chemicals and liquefied gases. They may also be accepted for elevated temperature service in boilers.

~~*9.1.3* Unless otherwise agreed, impact tests are not required for acceptance purposes. Where they are required, tests are to be made on longitudinal specimens at minus 196°C and the minimum average energy requirement is to be 41J.~~

9.2 Chemical composition

9.2.1 The chemical composition of ladle samples is to comply with the requirements given in Table 5.9.1.

9.2.2 Consideration will be given to the use of steels whose compositions are outside the scope of Table 5.9.1.

9.3 Heat treatment

9.3.1 All materials are to be supplied in the solution treated condition.

9.4 Mechanical tests

9.4.1 Tensile test specimens are to be taken in accordance with the appropriate requirements of 1.7.

9.4.2 The results of all tensile tests and impact tests are to comply with the requirements of Table 5.9.2 or the approved specification.

9.4.3 For austenitic stainless steel forgings, impact tests may be omitted subject to prior agreement with LR.

~~9.2~~ 9.5 Mechanical properties for design purposes

~~*9.2.1*~~ *9.5.1* Where austenitic stainless steel forgings are intended for service at elevated temperatures, the nominal values for the minimum one per cent proof stress at temperatures of 100°C and higher given in Table ~~5.9.1~~ 5.9.3 may be used for design purposes. Verification of these values is not required except for material complying with a National or proprietary specification in which the elevated temperature properties proposed for design purposes are higher than those given in Table ~~5.9.1~~ 5.9.3.

Existing sub-Section 9.3 *has been renumbered* 9.6.

~~9.4~~ 9.7 ~~Intergranular corrosion~~ Corrosion tests

~~*9.4.1* Where corrosive conditions are anticipated in service, intergranular corrosion tests are required on forgings in Grades 304, 316 and 317. Such tests may not be required for Grades 304L, 316L, 321 and 347.~~

9.7.1 Where corrosive conditions are anticipated in service, for grades 304, 316 and 317 intergranular corrosion tests are required in accordance with Ch 2,8.1. Such tests may also be required for grades 304L, 316L and 347.

~~*9.4.2* When an intergranular corrosion test is specified, it is to be carried out in accordance with the procedure given in Ch 2,9.1.~~

9.7.2 Where corrosive conditions are anticipated in service, for duplex stainless grades pitting corrosion tests are required in accordance with ASTM G48 Method C. For UNS S 31803 duplex stainless steels the test temperature is to be 25°C. Following the test, no pitting corrosion is to be observed at 20x magnification. The use of a weight loss method may be accepted subject to special consideration.

Table 5.9.1 Chemical composition of stainless steel forgings

Type of steel	Chemical composition % (*see* Note)								
	C	Si	Mn	S	P	Cr	Mo	Ni	Others
Austenitic									
304L	0,03	1,00	2,00	0,030	0,045	18,0–20,0	–	8,0–13,0	—
304	0,08					18,0–20,0	–	8,0–11,0	—
316L	0,03					16,0–18,0	2,0–3,0	10,0–15,0	—
316	0,08					16,0–18,0	2,0–3,0	10,0–14,0	—
317	0,08					18,0–20,0	3,0–4,0	11,0–15,0	—
347	0,08					17,0–20,0	–	9,0–13,0	Nb ≥ 10 x C ≤ 1,10
Duplex									
UNS S 31803	0,03	1,00	2,00	0,020	0,030	21,0–23,0	2,5–3,5	4,5–6,5	N 0,08–0,20
UNS S 32750	0,03	0,80	1,20	0,020	0,035	24,0–26,0	3,0–5,0	6,0–8,0	N 0,24–0,32 Cu 0,50

NOTE
Where a single value is shown (and not a range of values), the value is to be taken as maximum.

Table 5.9.2 Mechanical properties for acceptance purposes: stainless steel forgings

Type of steel	Tensile strength N/mm^2 minimum	1,0% proof stress N/mm^2 minimum	Elongation on 5,65 $\sqrt{S_o}$ % minimum	Reduction of area % minimum	Charpy V-notch impact tests	
					Test temperature °C	Average energy J minimum
Austenitic						
304L	485	170	30	50	–196	41
304	515	205				
316L	485	170				
316	515	205				
317	515	205				
347	515	205				
Duplex						
UNS S 31803	620	450	25	45	–20	41
UNS S 32750	800	550	15	40		

Existing Table 5.9.1 *has been renumbered* 5.9.3.

Chapter 7

Iron Castings

Effective date 1 July 2014

■ *Section 1*

General requirements

1.1 Scope

1.1.1 This Section gives the general requirements for ~~both~~ grey (flake), ~~and~~ spheroidal (nodular) graphite and compacted (vermicular) graphite iron castings intended for use in the construction of ships, other marine structures, machinery, boilers, pressure vessels and piping systems.

1.1.2 Where required by the relevant Rules dealing with design and construction, castings are to be manufactured and tested in accordance with Chapters 1 and 2, together with the requirements given in this Section and either Section 2 for grey iron castings, ~~or~~ Section 3 for spheroidal graphite iron castings or Section 4 for compacted graphite iron castings. Castings for crankshafts are additionally to comply with the requirements detailed in Section ~~4~~ 5.

1.7 Mechanical tests

1.7.2 The results of all tensile tests are to comply with the requirements given in Section 2, 3, ~~or~~ 4 or 5, as appropriate.

1.9 Rectification of defective castings

1.9.3 Repairs by welding are not permitted on grey cast iron ~~parts~~ castings or compacted graphite iron castings and generally not permitted for spheroidal or nodular graphite iron castings, but may be considered in special circumstances for spheroidal or nodular graphite iron castings. In such cases, full details of the proposed repair procedure are to be submitted for approval prior to the commencement of the proposed rectification.

■ *Section 3*

Spheroidal or nodular graphite iron castings

3.4 Mechanical tests

(*Part only shown*)

Table 7.3.1 Mechanical properties for acceptance purposes: spheroidal or nodular graphite iron castings

Specified minimum tensile strength N/mm^2	0,2% proof stress (*see* Note) N/mm^2 minimum	Elongation on $5{,}65\sqrt{S_o}$ % minimum	Typical hardness value HB (*see* 3.4.1)	Typical structure of matrix (*see* ~~3.5.1~~ 3.5.2)

■ *Section 4*
Compacted or vermicular graphite iron castings

4.1 Scope

4.1.1 This Section gives the specific requirements for compacted or vermicular graphite iron castings.

4.1.2 These requirements are generally applicable to castings intended for use at ambient temperatures.

4.2 Heat treatment

4.2.1 Where castings do not meet the specified mechanical property requirements in the as-cast condition, a corrective heat treatment may be carried out. This is to be restricted to a single heat treatment and the test coupons must be heat treated with the castings.

4.3 Test material

4.3.1 The test samples are to be as detailed in Figs. 7.3.1, 7.3.2 or 7.3.3. The dimensions of the test specimens and testing procedures used are to be in accordance with Chapter 2. Test samples of other dimensions may be specially agreed with the Surveyor.

4.3.2 The test samples may be either gated to the casting or separately cast.

4.3.3 Where separately cast test samples are used, they are to be taken towards the end of pouring of the castings.

4.4 Mechanical tests

4.4.1 The tensile strength and elongation are to be determined and are to comply with the requirements of Table 7.4.1. Minimum values for the 0,2 per cent proof stress are also included in this Table but are to be determined only if included in the specification. Typical ranges of hardness values are also given in Table 7.4.1 and are intended for information purposes.

4.4.2 Castings may be supplied to any specified minimum tensile strength grade.

4.5 Metallographic examination

4.5.1 Samples for metallographic examination are to be prepared for compacted or vermicular graphite iron castings. These samples are to be representative of each ladle used and may conveniently be taken from the tensile test specimens. Alternative arrangements for the provision of these samples may, however, be adopted subject to the concurrence of the Surveyor. They are, however, to be taken towards the end of the pour.

4.5.2 Examination of the samples is to show that at least 80 per cent of the graphite is in a dispersed, compacted or vermicular form. The remaining 20 per cent of the graphite may be in spheroidal forms. Details of typical matrix structures are given in Table 7.4.1 and are intended for information purposes.

Table 7.4.1 Mechanical properties for acceptance purposes: compacted or vermicular graphite iron castings

Specified minimum tensile strength N/mm^2	0,2% proof stress (*see* Note) N/mm^2 minimum	Elongation on 5,65 $\sqrt{S_0}$ % minimum	Typical hardness value HB (*see* 4.4.1)	Typical structure of matrix (*see* 4.5.2)
300	210	2	140 – 210	Ferrite
350	245	1,5	160 – 220	Ferrite/pearlite
400	280	1	180 – 240	Pearlite/ferrite
450	315	1	200 – 250	Pearlite
500	350	0,5	220 – 260	Fully pearlitic

NOTE
Proof stresses need only be determined if specifically requested.

Existing Section 4 *has been renumbered Section* 5.

■ *Section ~~4~~ 5*
Iron castings for crankshafts

~~4.1~~ 5.1 Scope

~~4.1.2~~ 5.1.2 Crankshaft castings in grey iron and compacted graphite iron are acceptable only for compressors, and the specified minimum tensile strength is to be not less than 300 N/mm^2.

Chapter 10

Equipment for Mooring and Anchoring

Effective date 1 July 2014

■ *Section 1*

Anchors

1.10 Clearances and tolerances

1.10.3 ~~The shackle pin is to be a push fit in the eyes of the shackle, which~~ The shackle pin to hole tolerance is to be no more than 0,5 mm for pins up to 57 mm and 1,0 mm for pins of larger diameter and the eyes of the shackle are to be chamfered on the outside to ensure a good tightness when the pin is ~~clenched over on fitting~~ fitted. ~~The shackle pin to hole tolerance is to be no more than 0,5 mm for pins up to 57 mm and 1,0 mm for pins of larger diameter.~~ The shackle pin is to mate with the shackle such that it can be inserted with moderate hand pressure, allowing disassembly if required.

1.10.4 The trunnion pin is to ~~be a snug fit within the chamber and~~ fit within the chamber such that it will achieve the closest fit which can be carried out by hand. The pin is to be long enough to prevent horizontal movement. The gap is to be no more than 1 per cent of the chamber length.

■ *Section 2*

Stud link chain cables for ships

2.1 Scope

2.1.1 Provision is made in this Section for a range of grades, U1, U2 and U3, of stud link chain and fittings intended for anchor ~~or mooring~~ cables for ships.

2.1.2 The requirements for ~~offshore~~ mooring chain cables are given in Section 3.

2.7 Welding of studs

~~*2.7.6* The size of the stud welds is to be in accordance with Fig. 10.3.1.~~

2.10 Proof load tests

2.10.4 If a link breaks during proof load testing, a sample consisting of three common links is to be taken from each side of the broken link and subjected to a breaking test as detailed in ~~2.10~~ 2.12. If either of these samples fails, the length of cable is not to be accepted. A thorough examination of all broken links is to be made to determine the cause of failure and, after evaluation, LR will consider the extent of cable which is to be rejected.

2.11 Dimensional inspection

2.11.1 The measurement of dimensions in 2.11.2 and 2.11.3 is to take place after the proof load has been applied to the chain and subsequently reduced to the load of 10 per cent of the proof load. All other dimensional checks are to be carried out without application of load.

2.11.2 On every 27,5 m length of chain, five links are to be selected for measurement of length to ensure that the maximum allowable tolerance on a length of five links is plus 2,5 per cent. No under-tolerance is permitted.

2.11.3 If a five-link length of chain exceeds the tolerance given in 2.11.2, then the entire chain is to be checked for length, five links at a time with an overlap of two links, which is to include the first five links. Oversize links are to be removed and an approved connecting link inserted.

2.11.4 Checks of all other dimensions are to be made on three links from every four 27,5 m lengths. All measurements are to be made on links selected by the Surveyor and are to be carried out to the Surveyor's satisfaction.

2.11.5 If one of the links detailed in 2.11.4 fails to comply with the required tolerances, measurements are to be made on all four 27,5 m lengths.

2.11.6 If more than one link in a 27,5 m length of chain cable fails to meet the tolerance requirements, all the links in that length are to be measured.

2.11.7 Links that fail to comply with tolerance requirements are to be removed and approved connecting links inserted. Where a significant number of links fail to comply with the tolerance requirements the chain is to be rejected.

2.11.8 The form and proportion of links and shackles are to be in accordance with a standard recognised by LR, such as ISO 1704; alternatively, the design may be specifically approved by LR.

2.11.9 Manufacturing tolerances on stud link chain are to be within ±2,5 per cent (taking into account that all components of the chain are to be a good fit with one another), except for those detailed in 2.11.10.

2.11.10 The nominal diameter, d, is to be the average of the diameters, measured in the plane of the link, d_c, and perpendicular to the plane of the link, d_p, *see* Fig. 10.2.1. The negative tolerance on the nominal diameter is not to exceed the following:

Minus 1 mm when $d \leq 40$ mm
Minus 2 mm when 40 mm $< d \leq 84$ mm
Minus 3 mm when 84 mm $< d \leq 122$ mm
Minus 4 mm when $d > 122$ mm

The plus tolerance on the diameter at the crown measured out of the plane of the link, d_p, is not to exceed 5 per cent.

2.11.11 The cross-sectional area is to be calculated using the nominal diameter, *d*. The cross-sectional area at the crown of the link is to have no negative tolerance.

2.11.12 The diameter measured at locations other than the crown is to have no negative tolerance. The plus tolerance is to be in accordance with Table 3.9.3 in Chapter 3 except at the butt weld where it is to be in accordance with the manufacturer's specification, which is to be agreed by LR.

2.11.13 Studs must be located in the links centrally and at right angles to the sides of the link, although the studs at each end of any length may also be located off-centre to facilitate the insertion of the joining shackle. The following tolerances in Fig. 10.2.1 will be accepted provided that the stud fits snugly and its ends lie practically flush against the inside of the link:

Maximum off-centre distance 'X': 10 per cent of the nominal diameter *d*
Maximum deviation 'α' from the 90° – position: 4°.

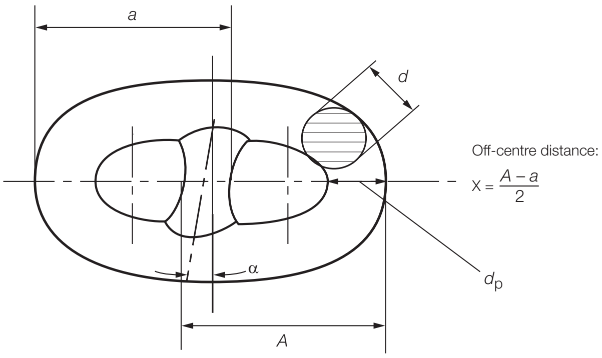


Fig. 10.2.1 Manufacturing tolerances

Existing Fig. 10.2.1 *to Fig.* 10.2.3 *have been renumbered Fig.* 10.2.2 *to* Fig. 10.2.4.

2.11.14 All individual parts must have a clean surface consistent with the method of manufacture and the surface is to be free from cracks, notches, inclusions and other defects which could impair the performance of the product. Crack-like imperfections less than 3 mm in length can be ignored. The flash produced by upsetting or drop forging must be properly removed.

2.11.15 Minor surface imperfections may be ground off so as to leave a gentle transition to the surrounding surface provided that the cross-sectional area remains equal to or greater than the nominal cross-sectional area. Remote from the crown, local grinding up to 5 per cent of the nominal diameter may be permitted.

2.11.16 Paint or anti-corrosive coatings are not to be applied until these inspections are completed to the satisfaction of the Surveyor.

~~2.11~~ 2.12 Breaking load tests

Existing paragraphs 2.11.1 *to* 2.11.5 *have been renumbered* 2.12.1 *to* 2.12.5.

~~2.12 Dimensional inspection~~

Existing paragraphs 2.12.1 *to* 2.12.10 *have been deleted.*

2.13 Fittings for chain cables

2.13.5 For mechanical testing, a ~~A~~ batch ~~of fittings~~ is ~~to be~~ defined as fittings of the same grade, size and heat treatment furnace load and is to have originated from a single cast heat of steel.

2.13.17 The following tolerances are applicable to accessories:

Nominal diameter: plus 5 per cent, minus 0 per cent
Other dimensions: ±2,5 per cent
The radii of all machined corners are to be not less than 0,03 times the nominal chain diameter.

~~*2.13.17*~~ *2.13.18* All fittings are to be stamped in accordance with ~~2.16~~ 2.15.

~~2.15 Dimensions and tolerances~~

Existing paragraphs 2.15.1 *to* 2.15.11 *have been deleted.*

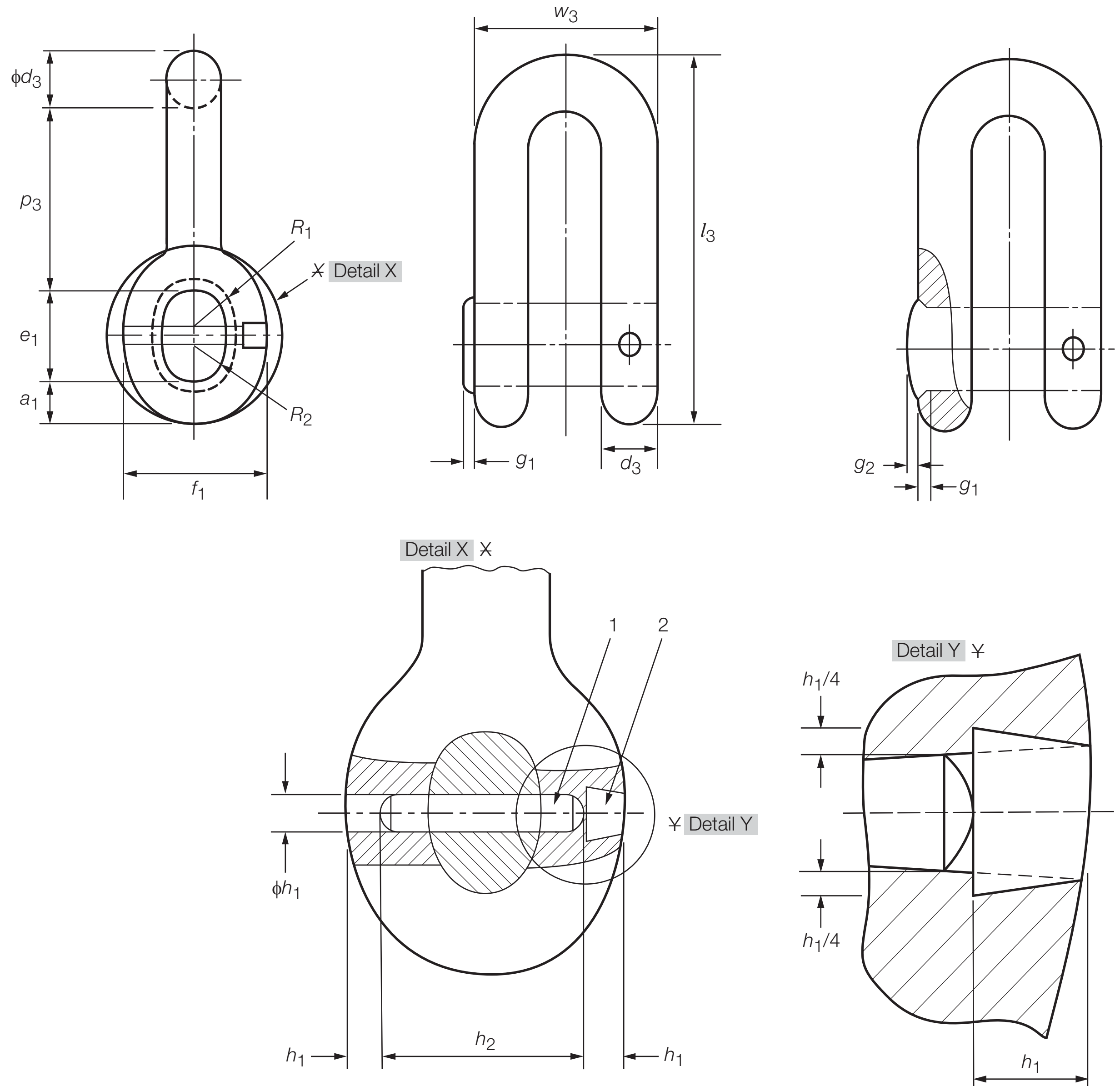
~~2.16~~ 2.15 Identification

Existing sub-Section 2.16 *has been renumbered* 2.15.

~~2.17~~ 2.16 Certification

~~*2.17.2*~~ *2.16.2* Each test certificate is to include the following particulars for all items included on the certificate:

(a) Manufacturer's name.
(~~a~~b) Purchaser's name and order number.
(~~b~~c) Description and dimensions.
(~~c~~d) Grade of chain cable.
(~~d~~e) Identification mark which will enable the full history of the chain or fitting to be traced.
(~~e~~f) Chemical composition.
(~~f~~g) Details of heat treatment.
(~~g~~h) Mechanical test results.
(~~h~~j) Breaking test load.
(~~j~~k) Proof load.

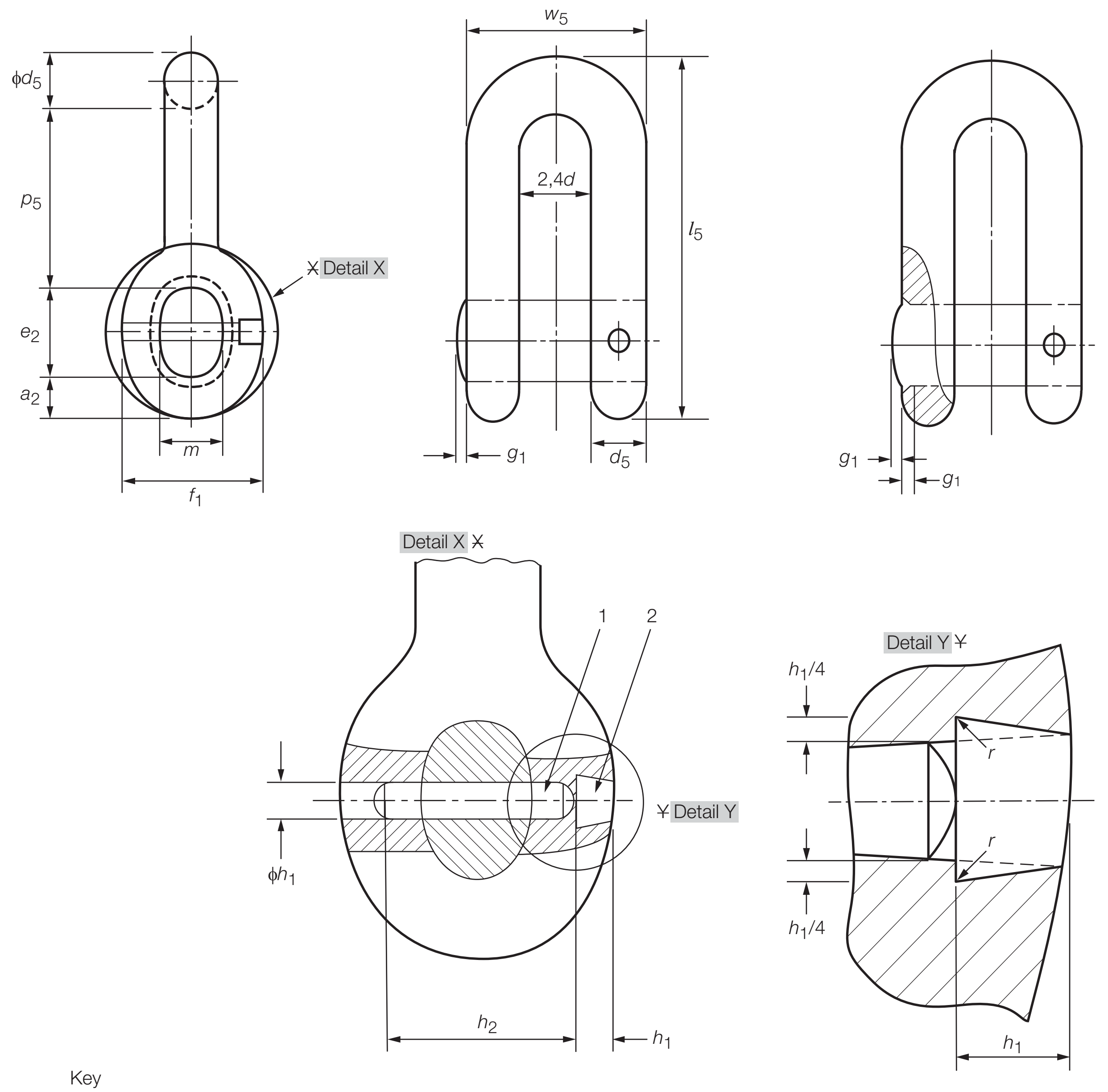


Key
1 ~~X~~ retaining pin
2 ~~Y~~ dovetail chamber

d = nominal diameter of common stud link
d_3 = nominal diameter of joining shackle = 1,3d
l_3 = 7,1d
p_3 = $l_3 - (d_3 + a_1 + e_1)$ = 3,4d
w_3 = 4d
a_1 = 0,8d
e_1 = 1,6d

f_1 = 2,8d
g_1 = 0,2d
g_2 = 0,1d
h_1 = nominal diameter of taper pin
h_2 = nominal length of taper pin
R_1 = 0,6d
R_2 = 0,5d

Fig. ~~10.2.4~~ 10.2.5 Dee shackle



Key

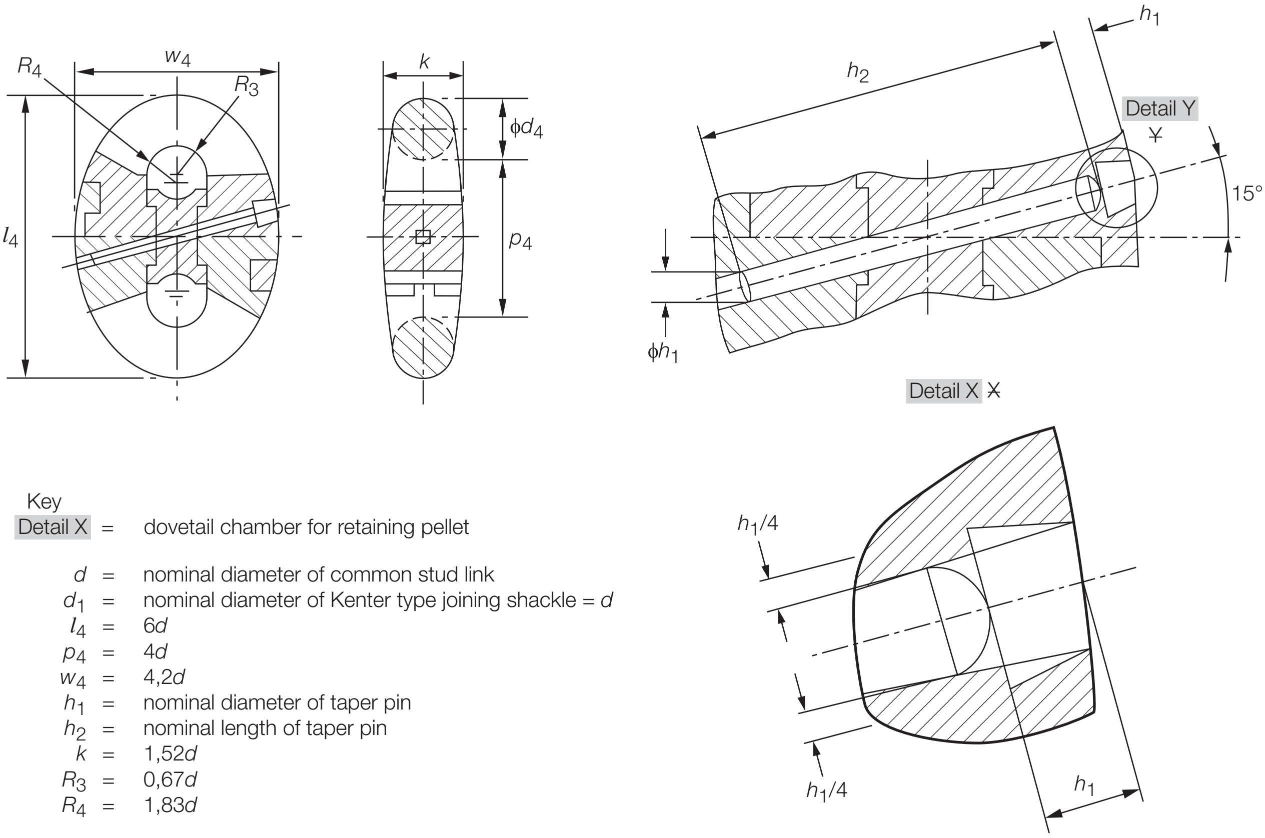
1 ~~X~~ retaining pin

2 ~~Y~~ dovetail chamber

d = nominal diameter of common stud link
d_5 = nominal diameter of end shackle = 1,4d
l_5 = 8,7d
p_5 = $l_5 - (d_5 + a_2 + e_2) = 4{,}5d$
w_5 = 5,2d
a_2 = 0,9d
e_2 = 1,8d

f_2 = 3,1d
g_1 = 0,2d
g_2 = 0,1d
m = 1,4d
h_1 = nominal diameter of taper pin
h_2 = nominal length of taper pin

Fig. ~~10.2.5~~ 10.2.6 End shackle



Key
Detail X = dovetail chamber for retaining pellet

d = nominal diameter of common stud link
d_1 = nominal diameter of Kenter type joining shackle = d
l_4 = $6d$
p_4 = $4d$
w_4 = $4{,}2d$
h_1 = nominal diameter of taper pin
h_2 = nominal length of taper pin
k = $1{,}52d$
R_3 = $0{,}67d$
R_4 = $1{,}83d$

Fig. ~~10.2.6~~ 10.2.7 Lugless shackle

Existing Fig. 10.2.7 *and* 10.2.8 *have been renumbered Fig.* 10.2.8 *and* Fig. 10.2.9.

■ *Section 3*
Stud link mooring chain cables

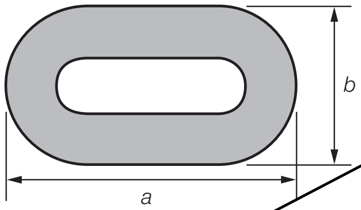
3.3 Dimensions and tolerances

3.3.6 The tolerances for common links are to be measured in accordance with Fig. ~~10.3.3~~ 10.3.2.

Fig. 10.3.2 Stud link chain cable common link tolerances

~~**Fig. 10.3.3 Studless and common link tolerances**~~

The internal link radii (*R*) and external radii should be uniform



Designation	Description	Nominal dimension of the link	Minus tolerance	Plus tolerance
a	Link length	6*d*	0,15*d*	0,15*d*
b	Link width	3,35*d*	0,09*d*	0,09*d*
R	Inner radius	0,60*d*	0	—

Symbols

d = nominal diameter of chain

NOTE
Other dimensional ratios are subject to special approval.

Existing Fig. 10.3.4 *to* 10.3.6 *have been renumbered Fig.* 10.3.3 *to Fig.* 10.3.5.

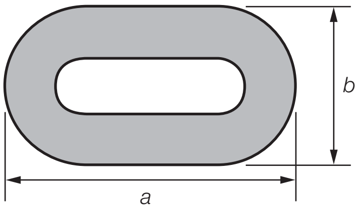
Section 4
Studless mooring chain cables

4.4 Dimensional tolerances

4.4.2 The tolerances for common links are to be measured in accordance with Fig. 10.4.1.

Fig. 10.4.1 Studless chain cable common link tolerances

The internal link radii (*R*) and external radii should be uniform



Designation	Description	Nominal dimension of the link	Minus tolerance	Plus tolerance
a	Link length	6*d*	0,15*d*	0,15*d*
b	Link width	3,35*d*	0,09*d*	0,09*d*
R	Inner radius	0,60*d*	0	—

Symbols

d = nominal diameter of chain

NOTE
Other dimensional ratios are subject to special approval.

Section 6
Steel wire ropes

6.5 Inspection

~~*6.5.2* Visual and dimensional checks are to be carried out in the presence of the Surveyor.~~

Chapter 12
Welding Qualifications

Effective date 1 July 2014

Section 6
Qualification of friction stir welding of aluminium alloys

6.1 Scope

6.1.1 The requirements of this Section relate to the Friction Stir Welding (FSW) of aluminium alloys. These requirements include requirements for verification of welding equipment, welding procedures, qualification of welding procedures and qualification of welding operators.

6.2 Welding equipment

6.2.1 Welding equipment (e.g., welding machines and FSW tools) is to be capable of producing welds that meet the specified acceptance levels.

6.2.2 Welding equipment is to be maintained in a good condition and is to be repaired or adjusted when necessary.

6.2.3 After installation of new or refurbished equipment, appropriate tests are to be performed to verify that the equipment functions correctly.

6.3 Weld procedures

6.3.1 This Section defines the requirements for welding procedures to be applied for FSW of aluminium alloys.

6.3.2 Manufacturers are to prepare a preliminary welding procedure specification (pWPS) defining procedures for how FSW is to be conducted.

6.3.3 A pWPS is to comply with the requirements of ISO 25239-4.

6.3.4 Qualification of a pWPS is achieved by conducting weld procedure qualification tests in accordance with ISO 25239-4. Minimum acceptance criteria for destructive tests are to be in accordance with these Rules. Reporting of the qualification tests are to be in accordance with ISO 25239-4.

6.3.5 Provided that the procedure qualification record lists all the relevant variables and there are no inconsistent features and the results satisfy the requirements, the procedure qualification record may be endorsed by the Surveyor as satisfying the requirement of the Rules.

6.3.6 A welding procedure specification (WPS) is to be prepared after the procedure qualification test report has been endorsed by the Surveyor.

6.3.7 For welding procedure specifications, the range of approval is to be limited as follows:

(a) **Manufacturer**. A welding procedure qualified by a manufacturer is valid for welding in workshops under the same technical and quality management.
(b) **Range of material type**. Approval is restricted to the specific aluminium grade and supply condition used in the qualification test.
(c) **Thickness**. Approval is restricted to the thickness of the test piece in the qualification test.
(d) **Joint types**. The joint types approved are to be those from the welding procedure qualification test only.
(e) **Welding tool**. Approval is restricted to the specific design of welding tool employed during the qualification test.
(f) **Other**. A range of approval for any other variables will be subject to special consideration.

6.4 Qualification of welding operators

6.4.1 Welding operators are to be qualified in accordance with ISO 25239-3.

6.4.2 Welding operators are to be suitably trained and will be required to demonstrate a knowledge of FSW and have a working knowledge of the welding installation. Knowledge of the FSW process may be demonstrated by exams passed during the training period. Demonstration of a working knowledge of the welding installation will be subject to the Surveyor's satisfaction.

6.4.3 Qualification of welding operators is to be by welding tests as specified in ISO 25239-3 or by conducting weld procedure qualification tests.

6.4.4 Upon successful completion of all necessary examination and tests, the welding operator is to be considered qualified. The range of qualification is to be as specified in ISO 25239-3.

6.4.5 A certificate of qualification is to be issued in accordance with ISO 25239-3.

Chapter 13

Requirements for Welded Construction

Effective date 1 July 2014

■ *Section 1*
General welding requirements

1.11 Non-destructive examination of welds

1.11.1 Non-destructive examinations are to be made in accordance with a definitive written procedure prepared and endorsed by a person qualified according to a Nationally Recognised Scheme with a grade equivalent to Level III qualification of ISO 9712, SNT-TC-1A, ~~EN473,~~ or ASNT Central Certification Program (ACCP). As a minimum, the procedure will identify personnel qualification levels, NDE datum and identification system, extent of testing, methods to be applied with technique sheets, acceptance criteria and reporting requirements. These procedures are to be reviewed by the Surveyor. *See* Ch 1,5.

1.11.2 Non-destructive examinations are to be undertaken by personnel qualified according to a Nationally Recognised Scheme with a grade equivalent to Level II qualification of ISO 9712, SNT-TC-1A~~, EN473~~ or ASNT Central Certification Program (ACCP). Operators qualified to Level I of the above schemes (or equivalent recognised by LR) may be engaged in testing under the supervision of personnel qualified to Level II or III (or equivalent recognised by LR). Personnel qualifications are to be verified by certification.

■ *Section 9*
Friction stir welding requirements for aluminium alloys

9.1 Scope

9.1.1 The requirements of this Section apply to the application of FSW during construction.

9.1.2 Prior to welding, the friction stir welding equipment is to have been demonstrated as being suitable for use.

9.1.3 Qualified welding procedures that have been approved by LR are required. Procedures to ISO 25239-4 that are endorsed by another Classification Society may be accepted if they are to the satisfaction of the attending Surveyor.

9.1.4 Welding operators are to be qualified to ISO 35239-3 standard. Where qualifications have been certified by another Classification Society, acceptance of the qualifications will be subject to document review and demonstration of knowledge of the FSW process and function of the FSW installation.

9.2 Production quality control

9.2.1 The general requirements for quality control are specified in ISO 35239-5.

9.2.2 Unless otherwise specified in relevant parts of the Rules, the following production tests will be required.

9.2.3 A production test is required when there is a change in procedure, a change in tooling, after equipment repairs or modifications, after deviation from optimum parameters are detected, when defects are identified by non-destructive testing, after continuous welding of every 100 m length during a single shift and with a maximum interval between procedure tests of 8 hours. For butt welds the production tests are to consist of 100 per cent visual examination, two face bend tests, two root bend tests and one macro section. For thicknesses exceeding 12 mm, sets of face and bend tests may be replaced by side bend tests. For test assembly, *see* Fig. 13.9.1. The production tests for other joint geometry are to be agreed between the Surveyor and the fabricator.

9.2.4 As an automated process, all essential variables are to be recorded by the FSW system. The welding operator is responsible for ensuring that the system continues to produce welds that are in compliance with the qualified procedure. Surveyors are to be informed when the system exceeds the operating parameters. Surveyors are periodically to review the welding records.

9.2.5 Production welds are to be subject to 100 per cent visual examination by the fabricator and be subject to random checking by the Surveyor.

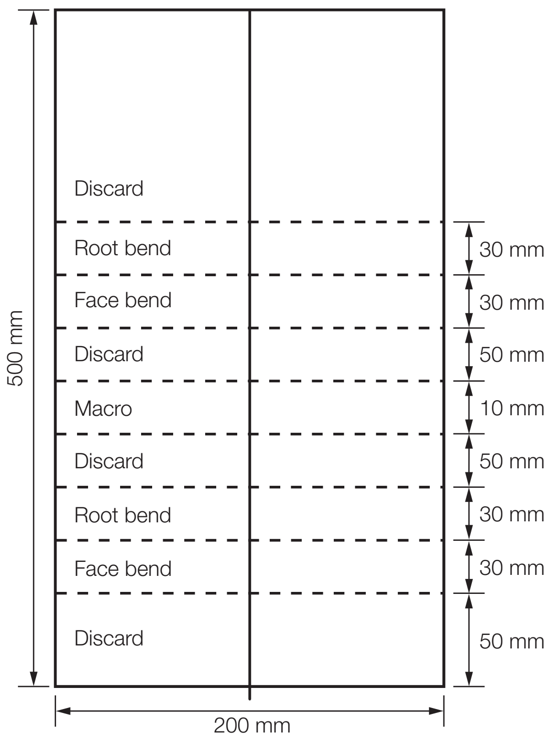


Fig. 13.9.1 Production test assembly for Friction Stir Welds

9.2.6 Surface and volumetric NDE testing is to be conducted on production welds at a frequency of two per welded panel or one every 100 m of weld, whichever is the greater.

9.2.7 Assessment of imperfections is to be in accordance with ISO 35239-5 Annex A and the requirements of Table 13.8.3.

9.3 Repair

9.3.1 All defective welds are to be reported to the Surveyor.

9.3.2 The manufacturer is to have an approved procedure for the repair of defective welds.

9.3.3 Weld repairs are to be conducted by qualified welders or welding operators in accordance with qualified weld procedures. Welding procedures and welders/operators are to be qualified in accordance with the requirements of Chapter 12 as appropriate to the welding process used for the weld repair.

9.3.4 All repairs are to be subject to 100 per cent visual, surface and volumetric NDE.

Cross-references

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Materials.

Chapter 7

2.3.1	Reference to Section 4 *now reads* Section 5

Chapter 10

2.13.17 now *2.13.18*	Reference to sub-Section 2.16 *now reads* 2.15
2.14.7	Reference to paragraph 2.16.1 *now reads* 2.15.1
3.3.1	Reference to Figs. 10.2.1 to 10.2.8 *now reads* Figs. 10.2.2 to 10.2.9
3.3.4	Reference to paragraph 2.12.1 *now reads 2.11.1*
3.6.11	Reference to paragraph 2.15.5 *now reads 2.11.12*
3.6.25	Reference to Fig. 10.3.4 *now reads* Fig. 10.3.3
3.8.11	Reference to Fig. 10.3.5 *now reads* Fig. 10.3.4
3.8.12	Reference to Fig. 10.3.5 *now reads* Fig. 10.3.4
3.8.15	References to Fig. 10.3.6 *now read* Fig.10.3.5

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